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An industry structured for unsafety? An exploration of the cost-safety conundrum in construction project delivery

Construction accidents can have major social, financial, reputational and legal implications. Hence, it is to be expected that safety is often presented as a key priority for construction organisations. However, existing evidence suggests that within the construction industry, safety often loses the battle when a trade-off is required with project cost. Improved understanding of the manifestations of the cost and safety interaction are needed. A three-year longitudinal study afforded the opportunity to investigate the safety implications of sub-economic bids on a large infrastructure project in the UK. While low-bidding to win tenders is not new, this paper presents empirical evidence of the consequential safety risk implications of such bidding at the project delivery stage. Faced with a perverse form of the tender ‘Winner’s Curse’ where the successful bid is frequently the lowest, cost-saving strategies are often implemented to recoup lost pricing margins. Our investigation revealed several instances of consequentially elevated safety risks, through cheaper and poor-quality equipment, machinery and temporary structures. In addition, lower-paid migrant workers – who already experience a statistically greater safety risk than local workers – were employed on the project without appropriate investment in a safety management approach suitable for a multinational workforce. The study both contributes to the call to critically rethink the construction industry’s competitive bidding practices, and highlights an industry structure that creates the conditions for high safety risks and accidents.

Keywords: competitive tendering, safety, risk, construction cost, injuries

Ethnographic prologue

The Health and Safety (H&S) manager returned to the department office from a senior executive meeting. He wandered towards his desk, muttering words that were often heard in the office: *'cost, cost, cost, programme, programme, and programme.'* One of the four H&S advisors present in the office joked: *'The power of pound. The pound is king.'* The H&S manager stopped, and turned to the advisor: *'Oh they are all for having 'stop the drops' campaign; but as soon as you raise the cost of tool tethers... there is a frosty reception.'* The construction manager joined the conversation: *'what do you expect...they want us to complete the job, under cost, under schedule, and under resourced.'*

The H&S team were in a support role on this project. Consequently, they could advise, but in most situations could not take pro-active action. However, they were not the only ones left frustrated at the imbalance between cost and safety, as the site management teams also had the challenge of managing cost pressures. One of the experienced H&S advisors went beyond the project, using a car analogy to describe the industry challenges faced: *'Until the UK construction industry changes, and doesn't shave you down pound by pound, you won't get the Range Rover product that consists of adequate supervision, best practice, the right equipment and going above and beyond the standards. Only then you get the product you want... with it being delivered safely – but that comes with a cost. We've got money for a Fiat Punto but they [pointing to client's office] want a Range Rover.'*

1.0 Introduction

The total costs of fatal and nonfatal injuries in the construction industry have been estimated as being a disproportionately high US\$11.5 billion when compared to other industries (Waehrer et al., 2007). These figures affect insurance costs, and also raise concerns around appropriate investment in accident prevention. This is arguably a very difficult question to answer considering construction site accidents are multi-causal events within complex socio-technical situations, rather than having a direct cause-effect relationship (Harvey et al., 2018). This complexity extends beyond accidents, as costs figures can be influenced by external social influences. For instance, in the US construction industry, Everett & Frank (1996:158) explained that the cost of workers' compensation insurance has skyrocketed, with there being 'a rash of third-party lawsuits as a result of accidents on construction sites'; and in the UK, Oswald et al. (2018a) revealed that fraudulent construction accident claims were seen as socially acceptable within some construction workgroups.

Despite these complexities, many researchers have attempted to estimate safety costs in construction, not least because the safety budget for construction projects has been identified as a factor that is related to the average number of accidents (López-Alonso et al., 2013). Within the construction industry, safety costs for construction processes are typically covered under the general expenses item of the construction site (Akçay et al., 2018). Feng (2013) found that the levels of investment have varying levels of effectiveness depending on the safety culture level and project hazard level, whilst Akçay et al. (2018) suggested that safety costs could be estimated based on the size of the actual construction work areas in the projects.

In terms of accident prevention, Pellicer et al. (2014) found that H&S costs for a case study construction project (which included insurance, prevention and accident costs) came to approximately 5% of the total cost of the project, which is about three times the average investment actually made for prevention. Ikpe et al. (2012) similarly found that accident prevention costs outweigh the cost of an accident by a ratio of approximately 3:1. While this perhaps suggests that more financial investment should occur within the industry, it is important to note that models proposed to estimate the costs and benefits of preventive measures are complex, as indirect costs can be hidden, hard to single out, identify, estimate and evaluate (Jallon et al., 2011). Previous research has tended to focus on such cost-benefit analysis for accident prevention in quantitative terms. Yet, *how* these accident prevention costs can be spent effectively, especially within the tight construction budgets the industry structure demands, is less well explored. This paper reveals empirical insights around H&S prevention costs to help close this gap in knowledge.

The wider construction industry structure also influences actions that occur at the project level. Hopkins (2019) explained how decentralised organisational structures (as typically found in the construction industry) allow for profit and production to take precedence over safety. The ethnographic prologue at the start of this article, including the statement “*they want us to complete the job, under cost, under schedule, and under resourced*” was a common theme in the findings of the research study presented here, and aptly sums up the focus of this paper. This prologue was extracted from a field note captured by the lead author on a major construction project (+ £500m) in the UK, with over 1000 inducted employees. The project had been awarded to a consortium with a winning bid that was approximately £250m less than the next nearest competitor. This paper therefore also acknowledges the lowest-cost tendering strategies, commonplace across the industry as a whole, and reveals the consequences of these practices and how they manifest as critical precursors for poor safety practices during project delivery. The overall aim of this paper is therefore to both investigate, illuminate and reveal the practical safety implications of sub-economic bids on a large infrastructure case-study project, and better inform how accident prevention costs can be spent most effectively within tight construction budgets, drawing on empirical data gathered through a three-year ethnographic approach. This work is able to make a

contribution to knowledge by revealing how the cost-safety conundrum is realised in practice, adding another facet of nuance and insight to the existing quantitative knowledge in this space.

2.1 Safety costs

Lopez-Alonso et al. (2016:625) define safety costs on building sites as: ‘the cost of the resources, goods and services employed in order to improve working conditions and to reduce the accident rate, together with those generated by the occurrence of incidents and/or accidents.’ These include ‘safety costs’, which are the resource costs needed to implement preventive actions that are either voluntarily or under legal obligation; and ‘non-safety costs’, which are tangible, intangible and extraordinary costs associated with not meeting safety standards. Extraordinary costs cover all the losses on building sites caused by events beyond the control of technical or human management.

From a contractor’s perspective, estimating the true costs associated with completing a construction project, and the eventual price offered to the client in a bid, can be a complex exercise. Bids need to factor in cost estimations to achieve various project goals; including completing the work in the required time, to the expected quality, and to not harm anyone during the process. Indeed, safety can represent a significant cost to employers (Finkel, 2015). Fellows et al. (2002) explained that safety costs can be categorised into two groups: costs associated with work accidents and accident prevention costs.

2.1.1 Costs associated with work accidents

Costs associated with work accidents can be direct or indirect. Direct costs are visible and obvious costs such as insurance premiums (Brody et al., 1990). Indirect cost resulting from work accidents are costs that are ‘absorbed entirely by the employer and which are usually not attributed to the specific accident, to overall accidents or which simply never enter the accounting system’ (Brody et al., 1990:260). In terms of accident costs, Feng et al. (2015) found the average direct and indirect accident costs were only 0.165%, and 0.086% of contract sum, suggesting direct costs are approximately double those of indirect. However, Haupt & Pillay (2016) found an opposing result with indirect costs being approximately twice that of direct costs. Sawacha et al. (1999) proposed that for every £1 of an accident cost paid by an insurance company, the contractor could expect to pay between £5 to £50 in indirect costs; and SafeWork Australia (2015) estimated that 25 per cent of the total costs are due to the direct costs of work-related incidents, with the other 75 per cent are accounted for by indirect costs such as lost productivity, social costs and legal fees. The range of conflicting figures emerging from the literature highlights the challenges in measuring direct and indirect accident costs.

2.1.2 Accident prevention costs

Accident prevention costs can be classified as compulsory or voluntary. Compulsory costs accrue from the minimum safety protection measures that are legally required, and which involve staff training, equipment and facilities (Akçay et al., 2018). Voluntary investments are costs that are not driven solely by legal requirements and can include safety initiatives, safety promotions, incentives, new technologies, and methods or tools designed for safety (Feng, 2013). Accident prevention costs can be further classified into three groups (Brody et al., 1990):

- *fixed prevention*: costs typically being incurred on plant and equipment before production begins and exist regardless of the accident rate.
- *variable prevention*: costs proportional to accident frequency rates and their severity. They are linked to the time taken for accident analysis, cause identification and implementation of corrective measures.
- *unexpected prevention*: costs initially unforeseen such as an equipment modification to lower noise levels, or changes in legislative requirements or cultural norms.

The amount of financial investment in prevention costs is linked to the overall budget of the project. López-Alonso *et al.* (2013) analysed 40 projects while they were in progress and reported three observations (the third particularly relevant for accident prevention costs):

- the number of accidents on the projects display a *positive* relationship with the total number of workers.
- the number of accidents on the projects also display a *positive* relationship with the average number of subcontractors. And finally,
- the number of accidents on the projects are *inversely* associated with the cost of accident prevention.

This relationship is important. While there are several possible reasons for accident causation on construction projects, some of which are beyond the control of workers and management, the implication of the third observation by López-Alonso *et al.* (2013) may indicate that time and capital investment in accident prevention programs are able to reduce the incidents of accidents and injuries.

2.2 The cost-safety trade-off

The concept of precursors is helpful for explicating the context and nature of safety incidents and accidents in work environments. As explored by Smith et al (2017), precursors (or antecedents) are the conditions or acts that precede and lead-up to unsafe behaviours and accidents. This concept assumes

that unsafe practices and incidents are usually symptoms that point to deeper, underlying precursors. Precursors are thus the “building blocks” of unsafe practices, and can include events both internal to an organization (such as resourcing, training, culture, equipment failures and human errors) and external (such as adverse weather events).

Love *et al.* (2018) extend the motif of precursors to identify three clusters of underlying sources of safety incidents – people, organisation and project. The focus on *people*, evidenced through risky behaviour, skills, knowledge, localisation of control and influence from management, is thoroughly explored in the extant literature (e.g. Fang *et al.* 2015; Loosemore & Lam 2004; Ng *et al.* 2005). The contributions of the *organisation* through its safety culture, incidence reporting, procedures, training programmes and incentive structure have also been explored in some detail (e.g. Fung *et al.* 2016; Lingard *et al.* 2015; Love *et al.* 2016). The third construct identified by Love *et al.* (2018) is at the *project* perspective – for example, the nature and type of task, schedule pressure. Included in the *project* category is the level and type of resource made available to complete the task – equipment, tools, training and induction, size of the project, etc. (Holt 2016; Manu *et al.* 2014). These usually have direct cost implications for completing the construction project (López-Alonso *et al.* 2013). Provisions for safety and the available project budget have a logical relationship - tight project budgets can lead to cost-safety trade-offs that prioritise getting the job at the lowest cost possible, inducing production pressures known to cause accidents.

While the conceptual clusters of people, organisation and project presented by Love *et al.* (2018) are helpful for understanding some of the underlying precursors to safety incidents in construction delivery, a fourth dimension could include the economics of construction business as dictated by the wider industry structure and its practices. Indeed, cost-safety trade-offs during construction delivery are often exacerbated by an industry structure characterised by high competition, low barriers of entry, low profit margins as well as the use of competitive tendering in the construction industry (Ahiaga-Dagbui & Smith 2014; Love *et al.* 2012).

Competitive tendering is the predominant procurement approach within the construction industry, particularly for publicly funded projects (Coggins *et al.* 2016; Gerber & Ong 2013; Ioannou & Awwad 2010). For clients, this is useful for maximizing the benefits of competition in terms of innovation, value and cost, while pursuing fairness and accountability in capital spending. While clients may select their preferred contractors based on best value frameworks, the most economically-advantageous tender, or even non-price features like innovation, experience and past performance, Chaovalitwongse *et al.* (2012) observed that the predominant approach adopted by clients is based on a ‘lowest price policy’ – the lowest bidder wins the contract. This is well-documented and supported in the construction literature (Ballesteros-Pérez *et al.* 2015; Coggins *et al.* 2016; Gerber & Ong 2013; Oviedo-Haito *et al.* 2014).

While competitive tendering may hold several benefits for clients in terms of bargaining power, it equally presents some commercial challenges to contractors, especially in a heavily oversupplied market such as the construction industry.

There is evidence to support the claim that contractors often submit unrealistically low tenders, in the hope of winning the bid and finding ways of recouping this loss through the mechanisms of change-orders and claims (Rooke et al., 2004; Coggins *et al.* 2016; Love *et al.* 2017). Chaovalitwongse *et al.* (2012) noted that “many bidders (construction companies) tend to submit bids that are likely to be lower than the actual project costs to survive and win the bidding.” In the same vein, Gerber and Ong (2013, p. 22) observed that in extreme cases “...contractors are motivated to win a tender by submitting an abnormally low bid notwithstanding any inherent complexities the project may face.” Coggins *et al.* (2016) also noted:

“...it is not uncommon for building contractors to adopt a marginal cost pricing strategy – where firms tender to cover the cost of labour, materials and plant (variable costs) to construct the contract works and whatever *contribution* they can obtain towards covering fixed costs such as head office overheads and returns/profits to the business owners – in an attempt to keep the business running in the short term...” (p. 44)

Coggins *et al.* (2016) further observed that this type of underbidding leads to the prevalence of tight, or even zero, profit margins in the construction industry. It would seem that a perverse form of the ‘winner’s curse’ comes into play¹ as the industry is structured in a way that encourages and perpetuates such organisational behaviour.

This competitive tendering process means that there is little room for error within bids (Morton & Ross, 2007) and Lingard & Rowlinson (2005) explained that this can discourage contractors from factoring in the cost of performing the work safely. While alternative performance-based procurement systems, such as the ‘best-value’ method exist, the lowest-bid remains the most prominent procurement method and as there is a need to reduce costs in order to win projects, there are few incentives for the contractors to pay attention to site safety (Guo et al., 2015). When there is a low bid, this usually means a lower profit margin, and so safety can be the first area of saving when budgets become stretched during project delivery (Guo et al. 2015). Unpaid costs for construction equipment, machinery, materials and labour to complete the job would rapidly become evident on the project, as they would be physically missing. However for safety, the physical value can be difficult to visualise, especially as contractors are often

¹ Capen *et al.* (1971) observed that in traditional competitive auctions, “the winner tends to be the player who most overestimates true tract value (p. 643). This is somewhat reversed in competitive tendering in construction where the winner tends to be the lowest price bidder (Coggins *et al.* 2016; Gerber & Ong 2013).

able to avoid a serious accident without significant investment, and hence it is perhaps not unsurprising that safety budgets within bids are often put under pressure during difficult financial times. Guo et al. (2015) found the average incident rate in one project was much lower than another because of the positive effects of ‘best-value’ bidding method on both safety budget and the level of safety efforts. This value should include occupational safety performance, not least because poor safety performance reflects badly upon construction clients (Lingard & Rowlinson, 2005). Yet while safety is often labelled as a value priority across construction sites; in order to gain business acceptance, there may need to be a levelling of site safety costs for competitive reasons (Finkel, 2015), arguably exacerbated by the industry structure as a whole.

Transaction Cost Economics (TCE), and its associated “lens of doing and being in business”, may offer a useful insight into understanding the dynamics between competitive tendering with price as the key differentiator, and safety performance during construction project delivery. Traced to Coase (1937) and popularised by Williamson (1985; 1988), TCE is concerned with the economics of *being in* and *getting into* business by “examining the comparative costs of planning, adapting, and monitoring task completion under alternative governance structures”(Williamson 1985, p. 2). Transactional costs are expenses incurred to provide goods or services. TCE thus helps to explain how complex contractual relationships must be governed to reduce cost and to create and maximise transaction value (Ketokivi & Mahoney 2017). TCE thus provides a prism for understanding which organizational responses offer the least-cost solution to govern a given transaction, otherwise referred to as *discriminating alignment* (Williamson (1985). Importantly, it helps to understand economic actors’ behavioural assumptions (opportunism and bounded rationality) as well as transaction characteristics in an environment of uncertainty, complexity, and market structure (Williamson 1985; Williamson 2010).

Thus, Williamson (1985) asserts that all things being equal, firms will adopt the most cost-effective strategy, even if it may seem opportunistic and unethical in some cases. This may partly explain why clients mostly use competitive tendering to engage contractors – it helps them drive down the price for which the contract is awarded, and in some cases, incentivise the supply chain to innovate in driving best value. On the other hand, a logical extension of the TCE theory is that contractors will pursue cost efficiency as far as practicable once they get the contract, in an attempt to maximise revenue and profit. This commercial driver is accentuated if contractors won the contract on tight, near-zero profit margins because of downward pushing pressures of competitive tendering. This has been identified as precursor for adversarial, variation-seeking behaviours (Ioannou & Awwad 2010), the frequent insolvency of some construction firms (Coggins *et al.* 2016), as well as poor safety performance during project delivery.

3.0 Research Methodology and Design

Construction safety research sits within socio-technical interactions, with multiple stakeholders, including clients, designers, construction managers, workers, unions, employer groups and regulators all playing a key role in influencing workers' safety in construction projects. In order to understand the human and social factors involved in construction safety, effective research requires the proper application of social science methods (Abowitz & O'Toole, 2010). In a recent analysis of construction safety research methods that drew on five highly ranked international journals and one international conference proceedings, Zou et al. (2014) concluded that there may be a gap between the direction taken by researchers and the practical needs of the construction industry with relation to improved understandings of safety. Costs are numerical and therefore it is no surprise that there has been a large body of work rooted in positivist traditions exploring the relationships between occupational H&S costs and accidents. However, Oswald et al. (2018a) argued there was a need to supplement such positivist approaches with alternative research methods, highlighting that a reliance on positivism will inevitably limit construction safety knowledge. Consequently, this research adopted an ethnographic approach to explore the implications and manifestations of limited accident prevention costs in practice.

Ethnography is the recording and analysis of a culture or society, typically based on participant-observation (as was the case here) and results in a written account of a people, place or institution (Coleman & Simpson, 1998). In this study, the emergent ethnographic data revealed insights into unsafe working practices that appeared to be closely associated with the financial constraints in place on the project. This was explored through use of moderate participant observation, which involved the researcher:

- observing a wide range of on-site activities;
- participating in organised site walks, and informal site walkarounds;
- attending site and H&S department meetings;
- informal discussions with senior managers, site managers, H&S advisors and site operatives.

The case study project was a multinational joint venture that had been created between four organizations, and their successful tender bid was approximately £250m less than the next nearest competitor. There were over 1000 construction trade workers on the site at peak, including steel-fixers, crane operators, scaffolders, carpenters, and welders. The researcher became a member of the project's H&S department and spent over 1500 hours at the research setting, making over 200 field records and collecting 150 units of documentary data. An overt research approach was adopted, where the researcher openly explained H&S was the topic of the investigation. Initial fieldnotes were captured according to their suitability within the social setting, which included typing notes into the researcher's mobile phone

when on-site; direct input into a laptop when in the office; or hand-written notes on minutes when in meetings. The researcher was viewed by the construction workers as having a 'trainee-like' role, where the underlying assumption was that he was aiming to gain employment as a H&S advisor in the future. This role created a social expectation for the researcher to ask many questions, which was helpful to unpack the actualities of the construction practices relating to safety. The data were analysed through a thematic approach, which identifies patterns across datasets relevant to addressing the research aims (Braun & Clarke, 2006). The thematic approach consists of six stages: familiarisation with data, generating initial codes, searching for common themes, reviewing them, defining and naming themes and producing a final report (ibid). Analysis of the ethnographic data resulted in the emergence of various prominent themes throughout the fieldwork period of this case study research project, a key one being the implications of cost-saving strategies on safety risks.

As a methodological note, expletives have been blanked out with * symbols, but have remained within the quotations to ensure authenticity. The results are presented in the following section, as associated with the different aspects of cost-savings and accident prevention costs that emerged from analysis of the data. Where quotes and vignettes are provided, these are simply representational of the wider data as a whole, and are included to help illustrate the findings and enhance understandings of possible sources of safety incidents, and associated costing strategies in construction through exemplars of practice.

4.0 Findings

It was widely acknowledged on the project that cost-cutting strategies were required to stay within the tight budget that had initially won the project for the consortium. For example, one site manager stated:

*'They [temporary staircases] are clearly cheap, but does it surprise you? Across the board everything's cheap... cheap tools, cheap equipment, cheap labour... add s**t with s**t, you don't get roses... My biggest concern is we are lacking experience. This is a massive project, we need guys with experience. I really hope that nobody gets seriously hurt, because I wouldn't wish that on my worst enemy.'*

Cost-cutting strategies were identifiable in the resourcing of materials, tools, equipment and labour (e.g. cheaper, inexperienced workers). These strategies reduced costs but increased safety risks.

4.1 Compulsory costs

4.1.1 Temporary works, structures and facilities

The following fieldnote demonstrates how temporary structures, such as internal access staircases, had been purchased as they were low-cost. Yet, they were of poor quality in the sense that objects were able to fall through gaps within the staircase structures:

Climbing the internal staircase you could hear drilling, hammering and the odd shout from a construction worker echoing down from near the top of the staircase. It was dusty and there were small chunks of concrete scattered all across the stairwell and the landings. On one staircase the H&S advisor noticed that there were gaps, which meant that tools or materials could fall through. He turned and said to me: 'you get what you pay for... it is not best practice, it is just a cheap design... if you were any skinnier you might slip through!'. The steel staircases had been recently constructed following extensive checks, as they had arrived lighter than expected, which initially suggested missing components.

Structures that were temporary were given less value on the project, and legal compliance became the only objective, rather than going beyond this minimum requirement. On the site safety walks, it became clear that spending money on temporary structures was resisted, as highlighted by the fieldnote below:

I observed a missing gate at the top of a ladder to the scaffold. Mentioning this to the H&S advisor, he explained 'I know, Jim [scaffolder supervisor] says they aren't buying gates any more. They say that 'you cannot put a price on safety' but it will be a battle to get a gate... We will get one though.'

Temporary facilities available to the workers were also affected by a cost-saving approach:

H&S advisor: *'The site had the bare minimum to get the guys working. It was set up with no running water, no chairs, soap, hand towels – we were lucky the unit had four walls. I spoke to the Head of Section and Foreman and they got it sorted. But we are still having issues. The cleaner hasn't been out in a month and the guys are living like rats. Welfare units looking like pig stys - no-one seems responsible for it... the workers are complaining there were 'too many men, not enough facilities'.*

Elbeltagi et al. (2004) recommended that the size and number of these facilities should not only reflect the site size, nature of the work, and the number of people who will use them, but also consider the type of work being carried out. For example, if many workers are undertaking substructure works which can be particularly dirty, more hand washing facilities may be needed.

4.1.2 Basic personal protective equipment (PPE)

Basic PPE includes the standard mandatory items on construction sites, which for this site was: hard hats, high-viz clothing, safety boots, gloves and light eye protection glasses. Other additional PPE is required by workers as dictated by the risk assessments undertaken for specific work processes as required by the UK's Management of Health and Safety at Work Regulations 1999.

I observed two H&S advisors' discussing another incident that related to poor quality of protective equipment in the H&S office. On this occasion an operative had set fire to himself, leading to the following discussion:

H&S advisor 1 (after fire incident): *'Do they know that it is fire resistant not fire proof?!'*

H&S advisor 2: *'He must have worked like this, (kneeling down acting out the operatives work motion) for the jacket to have those burns. It is a riskier stance to what he should take, but he shouldn't have caught fire. It is cheap protective clothing.'*

H&S advisor 1: *'Yes, they are poor quality.'*

During this fire incident, the H&S advisors concluded that risk-taking behaviour had occurred, and this could have been a consequence of risk homeostasis theory (see Wilde, 1998). This theory argues that individuals will adjust their behaviour in response to the perceived level of risk. The H&S advisors recognised the worker had adopted a riskier stance than normal after being provided with fire-resistant overalls, which created a (false) sense of reduced risk with regard to fire safety. There were several recorded incidents of the fire-resistant overalls catching fire, which in turn raised suspicions around their quality. Other protective equipment also raised concerns, including safety glasses and boots. For example, workers required multiple pairs of glasses, as they were very easily scratched within the site environment, as well as complaints of sore feet due to the safety boot quality. The perceived poor-quality safety boots were often linked to a higher than expected number of foot and ankle injuries:

H&S advisor: *'They are s**t quality. I think they are a factor as to why we have had so many ankle injuries. They offer a lack of protection. Barely cover the ankle. If they were another 2-3 inches higher, that would give more protection.'*

Olson et al., (2009) recommend that one way to encourage the use of PPE is to increase its availability but also its quality. High quality PPE can therefore not only increase usage, but also helps protect individuals against potential injury, however this does of course have associated costs.

4.1.3 Tools, plant and machinery

While H&S advisors raised concerns about some of the PPE, construction workers also raised complaints about the quality of their tools. For example, a discussion on this subject was raised as an item at a meeting with a H&S advisor and three worker safety representatives to discuss the results of a safety climate survey. The researcher sat in the meeting and observed the following discussion:

Operative 1: *'have you got any questions in there about tools... 'cause the tools we get are obviously bought 'cause they are cheap. They are all the tool are in red tags. It becomes a problem if you have to finish a job, but you're only allowed to use the tool for two hours'*.

Operative 2: *'Yea (nodding), and those whacker plates [vibrating compacting plates], they should all be an electric start'*.

H&S advisor: *'Agreed, I walked past one the other day and it looked older than me (50+)'*.

Operative 2: *'They are lethal [the outdated hand-start feature], it kicks back at you like a f****r'*

Tools with 'red tags' create high vibration when they are used, which can lead to worker health issues such as hand-arm vibration syndrome, a form of Raynaud syndrome. They are usually cheaper than low-vibration tools and acceptable if managed correctly with time limits placed on worker use. However, this meant that the time spent using these tools had to be carefully calculated in order to manage the red tag tools safely, and generated restrictions and challenges when the project was under schedule pressure. The cheap whacker plates with outdated starters were described as 'lethal' by an operative, and H&S advisor had questioned their quality simply based on their appearance. Although the cheap tools could be simply attributed to reducing plant resourcing costs, according to Zeng et al. (2008) one of the main reasons for poor safety performance is low safety awareness amongst organisations, such as the potential implications of this plant resourcing decision on worker health and safety.

4.1.4 Tool tethers

A further fieldnote example that demonstrates the resistance to expensive safety 'add-ons' was the use of tool tethers:

A recent first aid incident had occurred. An electrician had been hit on the shoulder by a falling hammer. The hammer was pushed out of a joiner's tool belt as he knelt down to fix gaps above with plywood (to stop falling objects). This incident was being discussed at a H&S meeting:

H&S Advisor: *'There is no doubt the area below should have been an exclusion zone... it was not in the ten-minute brief, and there was no signage. But the primary control measure should be to stop the drop. The tools should be tethered.'*

H&S Manager: *'It has been raised upstairs [senior management]. There were some concerns with the user-friendliness of the tethers, we need the guys to want to use them. That and when the pricing came out for tethering tools, it was met with a frosty reception. Cost, cost, cost, programme, programme, programme. But we have them now.'*

Workers explained that the tethers were not typically used and many simply did not want their own tools permanently tethered. The tools became impractical when the motion of the tool when tethered (e.g. twisting) made it difficult to complete the task. One operative stated:

'We are the guys having to use the tethers, but we weren't consulted. They just buy a bunch and expect us to use them when they might not work for all of us. We have scaffs, joiners, welders, all doing different work.'

The workers believed the tethers were not practical for all work tasks, trades or scenarios. The provision of tethers could therefore be seen as a wasted cost, as workers were not using the expensive protective equipment, however it did put the superiors at ease, at least from a legal perspective:

H&S advisor: *'The ironic thing is they may have cost a whack [a lot], and may be our best item of PPE, but they are sitting in the foreman's offices. The guys don't wear them. It is so we [principal contractor] can say, look, we have told the guys to wear them, its in the RAMS [Risk Assessment and Method Statement], we have them sitting there, if you don't wear them it's not our fault. Protecting ourselves, but what's it doing for safety, we have spent a load of money on tethers that are just sitting in a box. They don't come cheap either.'*

Paap (2003) proposed that in the construction industry safety should be interpreted in two forms: the official procedures and the actual working operations - a distinction between the rules stated and the rules that actually govern the workplace. This double-provision was described by Paap (2003:221) as 'a bait-and-switch, since it clearly serves to advantage the employers at the expense of the workers'. In an attempt to avoid this mismatch between rules and practice, contemporary thinking has led to workforce engagement, where workers are instead consulted about their safety (Sherratt, 2011) and how management provisions can actually optimise their safety on site.

4.1.5 Labour consultation

In the UK, there are Regulations for the provision of H&S committees and worker representatives. The HSE (n.d.) state that ‘if two or more union-appointed health and safety representatives request in writing that you set up a H&S committee, you must do so within three months of the request.’ Therefore, the time and resources required to set up and run these committees can be considered a compulsory safety cost. A H&S committee had been established on the project, yet faced challenges as work supervisors highlighted:

‘The guys [site-based workers] never knew about it; managers don’t say to go, to avoid losing guys [workers]. The Project Director wants more of the workforce there, but guys in the workforce ‘can’t say anything’ in-front of their bosses or head of sections.’

The committee was created and thus required the investment of resources, but consultation was still a challenge as it was not well-communicated; supervisors were under high production pressure so did not want their own workers to spend time at the meeting; and in the meetings the hierarchical power relations present meant that H&S insights from the front-line were not always shared openly or willingly. Cheng et al. (2012) stressed that the construction industry has paid relatively less attention to safety management committees, which they found to have a strong positive perceived impact on project performance. Without associated support and action, labour consultation on the project was an ineffective spend of compulsory costs and therefore did not derive the potential benefits from this investment.

4.1.5 Labour understaffing

The H&S advisors acknowledged that the project labour resources were ‘very thin on the ground’, particularly with scaffolders:

‘we are already light, especially on a Monday due to rotations....scaffolders are a rare breed on this project... and two more have just left...it is like a fiddle string out there, just getting tighter and tighter’

From a safety perspective, one of the scaffolder’s duties was to inspect and ‘sign-off’ a *scaffitag*, a physical sign that indicates temporary scaffold structures are safe for worker use. The lack of scaffolders on the project made this simple task for a competent scaffolder more challenging simply due to volume of work and the pressure to complete it quickly. Some scaffolders had left the project as the wage they were receiving was lower than they could secure on another site. This suggests that paying low salaries to try and save costs can create safety risks; since, for example, there could be no qualified scaffolders

present to determine whether access platforms were actually safe to use by others. Access platforms that had not been ‘signed off’ by scaffolders are still used by other trade operatives under production pressures to complete their work, creating an inherent safety risk should they be incorrectly constructed. This finding reveals a more nuanced safety risk consequence of paying low wages and consequential understaffing as found on this project, with regards to a specific and safety-critical trade.

Safety observation reports highlighted this lack of resources, across a variety of roles, as an unsafe condition on the site. For example, one report stated: ‘Lack of banksmen at formwork assembly yard’. Rowlinson and Yunyan (2015:187) stated there were ‘shortages of labour in an overloaded industry’; and from a review of the literature Ho (2016) identified that these labour or skill shortages in construction have occurred in many countries. Where there are shortages, migrant workers have been an important resource (Fellini et al., 2007). Shortages can suggest that there is a lack of skilled trades, or management expertise available. However, the research participants believed that there was also a cost-saving action being undertaken, by understaffing some site areas. This was not perceived as unusual on this project, as the need to keep to a tight budget was driven by the initial project bid, and a straightforward way to reduce costs was through fewer and lower wages.

4.1.6 Labour: Migrant workers

As well as filling potential labour gaps, migrant workers served other benefits, as they were typically hard-working, obedient and cost less to employ than local workers. One project civil engineer put it as:

‘They are hungry, will work all the hours, will do as they are told, and are cheap’

Fellini et al. (2007) reported that construction companies regularly recruit foreign workers to reduce labour costs, through the use of informal and sometimes illegal strategies. As the bargaining power of foreign workers is typically weaker than that of a domestic worker, immigrants often accept lower pay (Fellini et al., 2007). While, migrant workers may have cost less in terms of salary; they pose additional challenges and risks in terms of H&S management, as the H&S manager explained:

‘The bean counters just see the bottom line [initial cost]. Our migrant workers have been employed because they are cheap. Then we are tasked to manage workers we struggle to communicate with, workers that are inexperienced and workers that are not used to the UK standards and ways of working. We need resources for that.’

Migrant workers should not be disadvantaged in terms of safety; but statistics suggest they are at greater risk than local workers (see, for example, Byler, 2013; CCA, 2009; Meardi, 2012). One example of

migrant workers being disadvantaged in terms of safety was reported by Trajkovski & Loosemore (2006), when a construction site manager faced with a labour shortage fraudulently completed the safety induction assessments for his migrant workers, thereby cheating the safety management system but enabling them to commence work on the site. Bust et al. (2008) recommended a new approach was needed for the safety management of migrant workers; and Oswald et al. (2019) revealed that cost-neutral multinational communication strategies were limited and needed more careful consideration.

4.2 Voluntary costs

The project did invest in some voluntary safety costs by collecting proactive safety data through additional inspections and providing behavioural-based safety training. Cross Department Workplace Inspections were to be carried out as a proactive safety activity. However, in the H&S meetings there were serious fears *'it will turn into a war'*. In these meetings, H&S advisors were encouraged to *'act as a referee'* and ensure that the data that was gathered was agreed on by both parties. The workplace inspections were not the only voluntary safety activity that risked being unhelpful, with the observation system being described by workers as *'unproductive and creates backstabbing behaviour'*. One worker suggested the system needed alterations:

'Re-launch the system, with a strong lead given that it must not be used to avoid intervening at the time or as a means of firing bullets at others, or simply to moan about low-level rubbish! In the short term this may lead to a significant fall in the number of SORs [safety observation reports] submitted.'

Observations were recorded with an emphasis on 'closing out' any issues identified. Over 6000 safety observations were captured, with some having already been 'closed out' by the time they were documented, and others remaining unresolved. The administration of this system was both a timely and costly exercise, due to the number of safety observations, many of which were, as the H&S advisors repeatedly stated, *'not worth the paper they were written on'*. Proactive leading indicators have been recommended for use within construction safety management (see, for example, Hinze, 2013; Hallowell, 2013), yet implementation alone does not guarantee improved safety performance, and there are problems can arise that are actually damaging for project safety performance (Oswald et al., 2018b). Safety climate is typically considered a leading indicator (Votano et al., 2014); although it can also be considered lagging if analysed alongside accident or incident rates. At the beginning of the case study project, a consultant was employed to undertake a survey and analyse the safety climate of the project every few months. Yet, as project costs became tighter as the construction stages progressed, this cost was easily and swiftly removed by cancelling the contract and ceasing work with the consultant, thus any benefit for enhanced safety management derived from this financial

investment was also curtailed.

The project adopted a behavioural-based safety (BBS) approach, which was an overarching umbrella term used to cover the safety observation system and supplemental BBS training that was undertaken. However, the approach put in place did not involve calculating a site-safety observation score, nor did it involve a feedback loop that is present in other behavioural programmes, and the BBS training was aimed solely at supervisors. In one H&S meeting, the H&S Manager explained one of the purposes of the training:

'One of the things these BBS sessions are going to try and address is what supervisors need to do with respect to safety. Supervisors have been more focused on paperwork, they need to be more focused on the goings on, and supervise the work. They need to be more supervisor driven than paper driven.'

This goal represented a positive move from the drawbacks associated with the bureaucracy of safety (see Dekker, 2014); yet the mandatory training sessions were very poorly attended by supervisors. In one session, only two out of twenty invited supervisors attended, with the consultant admitting to the researcher that it was *'a waste of money'*. The lack of attendance could reflect Wilkins (2011) work, which found that the construction workforce is generally dissatisfied with training effectiveness. On the case study project, simply hiring a consultant and organising training sessions did not represent accident prevention costs well spent. The sessions were not attended partly due to the significant production pressure at the frontline, where supervisors play a crucial role. In the face of programme pressures and small profit margins, subcontractors are often squeezed so tight that investment in training and development activities are restricted, even in major organisations (Loosemore et al., 2003) and on sizeable projects such as this.

In addition, the behavioural safety initiatives were not widely accepted by the construction project as an effective strategy. Behavioural safety was often referred to as *'a big group hug'* by the workforce; which in a macho and masculine industry such as construction, can be a significant barrier to effectiveness (see, for example, Anderson, 2005; Cox & Jones, 2006), with experimental results having mixed fortunes in the construction industry (Lingard & Rowlinson, 1997). Even the H&S advisors, who arguably should be champions of all the safety initiatives on the project were divided with BBS. Within the team of eight there were some that supported the implementation of the programme, while others saw behavioural safety as *'a buzz word'* and *'an excuse for consultants to charge a lot of money'*. There also was a lack of clear understanding as to what the behavioural safety programme should entail, with one H&S advisor who undertook the training, stating:

'I wasn't sure what behavioural safety was, but after the training I realised I'm already doing behavioural safety'

The supervisor training revolved around successful safety interventions when workers were undertaking unsafe behaviours. The lack of understanding of BBS, the inherent production pressures on the project, and a lack of support for the programme actually resulted in this accident prevention cost being a poor investment.

5.0 Discussion

Safety is one of the performance delivery requirements for a 'successful' construction project, alongside time, cost and quality (Han et al., 2014). Safety should therefore not be isolated from these other project elements, and instead be considered an integral component of any construction project (Hinze, 1997). Safety costs can also be expressed through the benefits of production, since productive capabilities are enhanced as workers are not interrupted with accidents and injuries (Finkel, 2015). The HSE (2015) estimates that the total cost of work-related injury for the 2013–14 financial year in the UK was £14.3 billion. Hence, accidents create significant economic and social costs, and it is vitally important for improvements to occur in safety performance and business outcomes in the high risk and economically significant construction sector.

However, the current industry structure encourages winning tenders using sub-optimal bids, as was the case on this case study project. This created an environment and project culture which generally sets the commercial drivers that define the strategic goals of clients and contractors on a collision course. Clients pursue value-for-money and a product with the requisite functionality. Ultimately, clients seek a product at the lowest cost with the highest quality. Contractors, on the other hand, aim to increase their revenue and maximise profit. Ideally, they would prefer not to significantly exceed the agreed minimum specifications of compliance in the contract, especially if it reduces their profitability. It is thus not illogical to claim that contractors may sometimes trade-off quality and effective safety provision in an attempt to get the job done quickly or at lowest expense possible. This is consistent with the principle of *discriminating alignment* in transactional cost economics – i.e. in an attempt to reduce cost and maximise profits, organisations would often chose the least-cost solution to govern any given transaction (Williamson 1985). The value of transactional costs can be significant for contractors. Analysing six case studies, Whittington (2008) found that pre-construction transaction costs in design-bid-build and design/bid projects range from 0.4-8.8% and 0-5.7% of total contract value, respectively.

The post-contract transactional costs in Whittington (2008) can be as high as 14.7% of contract value in design-bid-build projects and averaged 9.5% in design-build projects.

Thus, there is little tangible incentive for contractors to go beyond the minimum compliance requirements of safety regulations given the current industry structure. According to Ratay (1997), good codes and standards can improve construction safety at minimal or no extra cost. However, poor codes and standards can contribute to disputes and increased costs with little or no effect on construction safety. The findings from this case study project revealed that while the codes and standards in the UK can be perceived as advanced, they were still subject to misapplication. For example, tool tethers would be purchased in an attempt to avoid dropped tools and meet legislative requirements; yet workers were not involved in the decision-making process for selection of the type of tool tethers which were felt to be unworkable and would therefore not typically wear them. Also, the safety steel toe-capped boots that were purchased to meet legal requirements were poor quality and were considered a contributing factor in ankle injuries that occurred on the site, the cost saving here creating new safety hazards in practice.

This work makes a valuable contribution by revealing how those at the frontline on this case-study project acknowledged that compulsory accident prevention costs were typically for legal compliance, but also cheap, and low quality, which suggested minimum safety standards were acceptable. Yet spending extra on basic safety equipment, to meet the workers' needs, and improve the quality, not only has the potential to reduce safety risks, but sends a message to the workforce that safety is an important value. The opposite message is conveyed when companies purchase poor quality safety equipment; or equipment that is not appropriate (such as tool tethers for steel fixers that do not allow for twisting motions) for the workers is purchased without their consultation. The industry structure and consequential high competition, generally low-profit margins and low barriers of entry found in the construction industry arguably discourage contractors from factoring in appropriate costs to provide the plant and material resources to perform the work safely. Although safety is often described by project managers as the number one priority, the findings from this case study project found cost to be a major influence on the management of safety in practice in a number of different ways.

Labour resourcing, in the form of understaffing and employing inexperienced personnel on this construction project could also be interpreted as a deliberate cost-saving approach, rather than an unfortunate outcome of labour shortages. The lack of qualified and experienced personnel on the project was of concern to the H&S team. In previous ethnographic studies, Aboagye-Nimo et al., (2015) explained that experienced workers can pass local knowledge to less experienced workers through on-site training; and Baarts (2009) revealed that experts and experienced construction workers have practised and observed for long enough to know about different situations, and therefore can anticipate and thus manage looming dangers on site. On this project, there were safety-related challenges when

there were insufficient numbers of a particular trade or trained personnel for a task; such the lack of scaffolders being able to competently assess if the temporary structures were safe. A motivator for the scaffolders to leave was that they could receive a higher wage elsewhere on another project. Hence, negotiating low wages to save costs created problems when employees later left for higher wages. These employees would have to be replaced – a process not without its own direct cost – while in the meantime their absence created safety issues.

Migrant workers have been an important resource in construction for filling labour gaps, but there were suggestions in this study that they were also employed because they were lower cost than the local workers. Fellini et al. (2007) reported that construction companies recruit foreign workers to reduce labour costs, often through the use of informal and sometimes illegal strategies. As the bargaining power of foreign workers is typically weaker than that of domestic workers, they are more likely to accept lower pay (Fellini et al., 2007). While migrant workers may have cost less in terms of salary this is something of a false economy as they can pose additional challenges and risks in terms of safety management. Additional risks are associated with communication barriers and cultural differences need to be properly assessed with the development of more sophisticated safety management systems (Oswald et al., 2019), which are likely to incur additional costs, such as professional translators.

Forward-thinking companies desire to go beyond legislative compliance, and invest in voluntary accident prevention costs. This can include behaviour-based safety (Li et al., 2015), culture and behaviour change approaches (Dejoy, 2005), training (Demirkesen & Arditi, 2015) and the collection of proactive leading indicators (Hallowell et al., 2013), as well as the fundamental lagging indicators typically required by law. However, many workers on the case study project did not believe the behavioural approaches implemented were effective; which is arguably understandable considering over the past twenty years in the UK there has been a lack of evidence of their success (Sherratt & Farrell, 2011). This lack of belief acted as a commitment barrier to the approach, and created a perception that it was an accident prevention cost that was poorly spent.

6.0 Conclusions

Accident prevention costs have found to be a worthwhile investment by previous quantitative studies. However, it is not well understood how these costs are best used in an industry which is traditionally structured to operate within very tight margins. As industry clients and contractors alike continue to award contracts on a lowest-cost basis, rather than best value, the negative implications for safety risks on projects must continue to be highlighted. Projects on very tight profit margins from the outset arguably have to take extra risks in their safety management in order to stay on schedule and under

budget. These extra risks are linked to resourcing in the form of hiring inexperienced and cheaper labour, reducing staff, and the use of poor-quality personnel protective equipment, tools and temporary structures.

The prevention costs for safety need to be more carefully considered. The evidence in this study suggests that choosing an initial low-cost option for safety equipment and resources, may not actually be the cheapest, nor the best for safety. For instance, cheaper inexperienced or migrant workers, will require to be more closely managed with regard to safety, which will represent an extra cost. Also, cheaper forms of PPE, are likely to be poorer quality, contribute to more accidents, and have to be replaced more frequently. The approach of choosing the lowest-cost options to achieve minimum standards also sends a message to the workforce that safety is not prioritised over cost. This is often the opposite of company rhetoric that aims to demonstrate safety is the priority.

Construction companies are arguably operating within an industry structure that only allows for the lowest-cost option to be chosen, as the winner of the tender almost always tends to be the cheapest bid. Hence, before any construction work has begun, the budgets are tight, and the cost of doing the work in an unsafe manner is likely to have to be risked on occasions throughout the project. It could be reasoned that more responsibility should lie with the client, by ensuring the best-value bid is selected, rather than the cheapest. Perhaps, government clients, seeking to represent 'model client behaviour', should consider this more highly, as one of their fundamental duties for setting their projects up for success. A call is made here for clients to assess for best-value, researchers to help assist clients in how best-value can be determined, and for construction companies to tender for not only the cost of the work, but for also completing it safely. Hence, further research is encouraged to identify through robust methods how the industry structure should change. For example, studies could explore how best-value can be determined, how regulation could help, or how pre-qualification tender criteria could be improved to further focus on safety. As until the whole industry structure changes, it will continue to be structured for failure, where the lowest bids will continue prevail, and safety risks and accidents will remain high.

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